tion of RS/GIS to specific disease issues through Interagency Agreements with the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and university investigators. The collaborative applications of CHAART technologies include development of a national risk map for Lyme disease in the Northeastern U.S.; effects of climate change on both Lyme and Hantavirus in the U.S.; ecology of malaria vectors in Kenya; and cholera in Bangladesh and Latin America.

In addition, a new RS/GIS training collaboration in health applications is being developed with the World Health Organization's (WHO's) Special Programme for Research and Training in Tropical Diseases (TDR). This is an outgrowth of the 1995 joint TDR/CDC/NASA training workshop in Guatemala, the 1998 workshop in China, and the 1999 UNISPACE III conference in Austria. CHAART investigators continue to collaborate with the United Nations (UN)/WHO interagency Roll Back Malaria and HealthMap programs. A series of meetings were also held between representatives of the World Bank's AFTH-2, CHAART, and NASA Headquarters, Life Sciences Division to define the goals and objectives of the NASA/World Bank collaboration. This collaboration will also include participation by WHO's HealthMap group. An agreement between NASA's Ames Research Center and the World Bank's AFTH-2 program is currently under development and is expected to be signed in early 2000. New opportunities in training are also being discussed with NOAA (climate variability and health) and the USGS (database development and integration in health planning and surveillance).

NASA CHAART also participated in the development of a National Science Foundation (NSF)/NIH interagency Request for Proposals on the Ecology of Disease. The role of CHAART will be to provide RS/GIS training in support of funded research proposals. Discussions continue between CHAART and the staff of the U.S. Embassy to develop a U.S./Japan collaboration in RS/GIS and health.

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Geothermal Springs Camera and Sensor Probe

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The Geothermal Springs Camera and Sensor Probe (aka Mini Monster Cam) is a research instrument developed to support the search for life in extreme temperatures. The purpose of the probe is to find and observe eukarya (multicell organisms) in the depths of geothermal hot springs. Although we know that single-cell organisms proliferate in hot springs, the probe will help prove or disprove the existence of eukarya (Mini Monsters) that might feed on the single-cell organisms. This work is part of a larger effort to define the limits of life on Earth to help narrow the search for life on other planets. During a deployment to Yellowstone National Park (see figure 1), the probe was lowered 60 feet into geothermal springs with temperatures up to 120 degrees Celsius.

The 5-inch-diameter probe holds two underwater cameras, a dissolved oxygen sensor, a pH and temperature sensor, and a pressure (depth) sensor. Each camera and sensor has a 100-foot cable; this setup and a steel pull cable are covered with a plastic sheath for ease of handling. The sensors and cameras are connected to an instrument case that contains the system batteries, two digital video monitor/recorders,

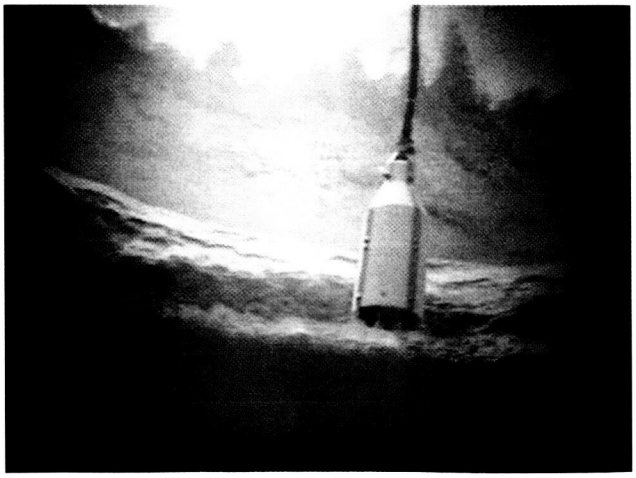

Fig. 1. The probe enters a hot spring at Yellowstone.

electronic instrumentation for the sensors, and a laptop computer for data viewing and storage (figure 2). The instrument case is specially fitted on a backpack for use at field sites inaccessible to vehicles. To precisely position the probe over the springs, a rigging system of tripods, ropes, and pulleys is set up. The rigging allows for safe operation around the deadly hot pools while making minimal environmental impact.

The two cameras in the probe are commercially made cameras designed for inspecting hot plumbing. One camera focuses to infinity and the other has a macro lens to look closely at life forms directly in front of it. The probe can be fitted with removable bait baskets in front of the camera to enhance the prospects of observing life in extreme temperatures. Exploring the biology of hydrothermal vent systems on Earth has piqued NASA's interest because it is currently thought that hydrothermal vent systems are the most likely habitats for life on Mars and Europa, a moon of Jupiter.

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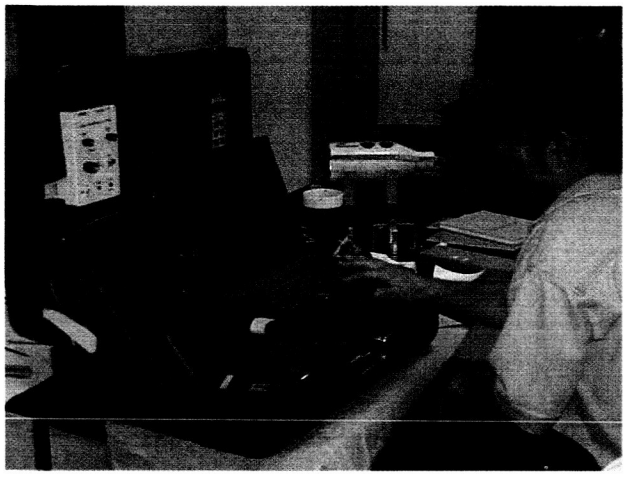

Fig. 2. Testing at ARC.